

# A Paradigm Shift from Mounted Intra-Oral Periapical Radiography to Hand-Held X-Ray Device: A Review

Gargi Patil<sup>1</sup>, Vishwas Kadam<sup>2</sup>, Lata Kale<sup>3</sup>, Sonia Sodhi<sup>2</sup>

<sup>1</sup>Post Graduate Student, Department of Oral Medicine and Radiology, CSMSS Dental College & Hospital, Aurangabad, Maharashtra.

<sup>2</sup>Reader and Associate Professor, Department of Oral Medicine and Radiology, CSMSS Dental College & Hospital, Aurangabad, Maharashtra.

<sup>3</sup>Professor & Head of Department, Oral Medicine and Radiology, CSMSS Dental College & Hospital, Aurangabad, Maharashtra.

Received: October 2019

Accepted: October 2019

**Copyright:** © the author(s), publisher. It is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

Handheld X-ray devices are now offered in dental practice. Handheld X-ray units challenge the concept of a restricted access to the “controlled area” as they are held by the operator. Although an integral lead shield is provided, the distance from the body is variable, dependent on how the device is held. Currently, there are voluntary guidelines provided by the NCRP for dental radiation protection. Hand-Held portable X-ray devices are increasingly used for intraoral radiography.

**Keywords:** Hand-Held X-ray Device, Intraoral radiography, National Council on Radiation Protection and Measurement.

## INTRODUCTION

Dental radiographs are an integral part of everyday clinical dentistry. Dental X-ray equipment are commonly fixed (wall, floor or ceiling mounted) or mobile (tripod mounted on a set of wheels). A fairly new concept is the handheld, battery operated, portable X-ray unit which has come on the market.<sup>[1]</sup> Although the first handheld portable dental X-ray devices date back to the early 90s of the past centuries, those devices were intended to be used in the military field. An increase in the marketing of handheld portable X-ray devices for intraoral radiography in general dental facilities has been recently observed.<sup>[2]</sup> The advertisements include both safe certified/approved units according to the International Electrotechnical Commission/European Committee for Electrotechnical Standardization (IEC/CENELEC) standards and potentially unsafe non-certified devices.<sup>[3-5]</sup> It is designed to be used by holding the integral handle with outstretched hands, away from the body, parallel to the ground and activated at arm's length distance.<sup>[1]</sup>

The mode of use has raised a number of questions over possible radiation safety issues affecting the

operator. Maintaining a safe distance, outside the “controlled zone”, and not holding the X-ray equipment are universally recommended when using fixed or mobile X-ray units to avoid exposure from radiation leakage from the X-ray tube head and from backscatter. The “controlled area” is a zone 1.5m in any direction from the patient and X-ray tube head and anywhere in the line of the main X-ray beam. Any radiation outside the “controlled area” is sufficiently attenuated by distance or shielding.<sup>[1]</sup>

In addition to this, the operator is required to be well outside the “controlled area”, at least 2m from the X-ray source. The available literature on handheld portable X-ray devices showed that the amount of radiation experienced by the patient and operator are below the recommended dose when the effective dose is calculated directly. Hand-Held portable X-ray devices are available online only at present.<sup>[1]</sup>

### Types of Hand-Held X-ray devices

1. NOMAD
2. Non-FDA-cleared device
3. Tube-based X-ray fluorescence

### Uses of Hand-Held X-ray device

1. Use in nursing homes
2. Home health care
3. Patients with disabilities like medical, mental or psychological
4. Patients on sedation who are unable to cooperate
5. Forensic work
6. Dental camps.<sup>[7]</sup>

### Name & Address of Corresponding Author

Dr. Gargi Patil,  
Post Graduate Student,  
Department of Oral Medicine and Radiology,  
CSMSS Dental College & Hospital,  
Aurangabad, Maharashtra.



**Figure 1: Portable x-ray device used in routine practice**

#### **Specifications of X-ray device**

Hand- held X- ray machine offers portability in X- ray technology, featuring cordless operation, rechargeable 14.4- V nickel-cadmium battery packs, and provides more than 100–700 exposures on a single charge. It weighs 8 pounds, has internal lead shielding, and an external lead-acrylic backscatter shield. There is an automatic shut off and “Enable” feature that minimizes the risk of inadvertent exposure. The hand- held X- ray device uses direct current, operates at a fixed 60 kV, 2.3mA, and has a 0.4 mm focal spot with a 20cm source- to- skin distance.<sup>[7]</sup>

#### **Radiation protection of the patient**

The aim in any radiographic procedure is to reduce the amount of radiation as low as diagnostically achievable.

1. Digital sensors reduce the dose per image by 1/4 th to 1/10th compared with conventional film.
2. Beam is limited to 6cm diameter, rather than the allowed 7cm. This smaller irradiation area reduces the patient dose by 25%.<sup>[7]</sup>

#### **Radiation protection for operator**

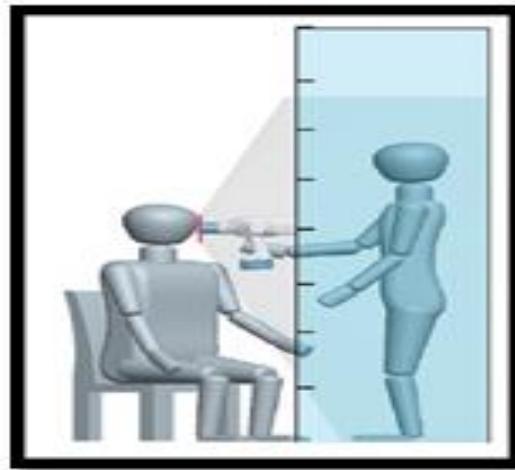
1. Operators should always wear personal protective equipment (PPE) while using the hand- held equipment to be shielded from backscatter radiation. Both an apron (with 0.5mm lead equivalent) and thyroid collar are recommended.
2. X- ray unit must only be operated by trained personnel in a controlled setting.
3. Any ancillary person should stand 3m (approximately 9 feet) away from the patient and if necessary, to be closer than 3m, should stay out of direct X-ray beam.<sup>[7]</sup>

#### **Backscatter Radiation**

- The operator (and any other staff involved in the radiographic examination or members of the public other than the patient) must be adequately protected from backscattered radiation.
- This is currently achieved most effectively by a backscatter shield installed at the end of the

position indicating device of specific lead equivalent thickness and diameter.<sup>[2]</sup>

- According to Food and Drug Administration requirements, this shield should have a minimum specification of 0.25-mm lead equivalent, be 15.2cm in diameter and be capable of being positioned no further than 1cm from the end of the position indicating device so that backscatter radiation is sufficiently blocked.<sup>[9]</sup>



**Figure 2: Position of patient and operator during exposure**

#### **Image quality**

1. Image quality is same as that of fixed intraoral x-ray units.
2. 0.4mm focal spot produces sharp, high resolution images. No blur from hand movement.
3. High- frequency, 60- kV DC X- ray generator produces clear image while reducing patient dose.<sup>[7]</sup>
4. In the study of Pittayapat et al, it was concluded that handheld portable X-ray devices produce satisfactory image quality for use in forensic odontology.<sup>[8]</sup>

#### **Security, storage, and transportation**

The optimal storage location is cool, dry, and away from direct sunlight.<sup>[7]</sup>

#### **Battery**

The charging for 30 to 45 min can be used for 8 hours. Color red indicates low battery.<sup>[7]</sup>

#### **Advantages of Hand-Held X-ray device**

- Operator can be with a patient during exposure.
- It is twice as fast as conventional x-rays.
- No of retakes is reduced by half.
- It is handy, portable and can be easily carried from one place to another.
- Can be easily used even if patient is reclined, in supine position or upright.
- Less chances of cone cuts and other errors.
- No need of remotes and special stands.

- Hundreds of diagnostic quality px-rays can be taken with a single battery charge.
- Works with sensor, film and phosphor plates.
- It is perfect for use with sedative patients and patients with mental disability.

### Disadvantages

- ALARA principle is not followed.
- Compulsory lead apron for operator.
- Operator cannot be in complete protection zone.
- Expert operator is required.<sup>[7]</sup>

### Quality assurance

- The Holder (natural or legal person who has the legal responsibility under the national law for a given radiological installation) shall arrange quality assurance procedures for practices involving exposure to radiation, and a quality assurance programme is required.
- Quality assurance practices shall be assessed regularly and, when appropriate, changed.<sup>[2]</sup>
- Quality assurance can be categorized as assurance of the technical quality and assurance of the operational quality.<sup>[10]</sup>

### Training

- Users of handheld portable X-ray devices shall provide proof of training for the safe use of radiation sources so that he/she understands the risks involved when using the handheld portable X-ray device and radiation protection measures to be taken.<sup>[2]</sup>

## CONCLUSION

It is very easy to set up and use in routine clinical practice. It is very useful in forensic dentistry, nursing homes, humanitarian missions, disabled patients. It is beneficial for both operator as well as patients as it is less time consuming. Many more studies can be done on such a new technique ahead.

## REFERENCES

1. Jimmy Makdissi, Ravikiran R Pawar, Ben Johnson and Bun S Chong; The effects of device position on the operator's radiation dose when using a handheld portable X-ray device; Dentomaxillofacial Radiology (2016) 45, 20150245.
2. W E R Berkhouit, A Suomalainen, D Br " ullmann, R Jacobs, K Horner and H C Stamatakis. Justification and good practice in using handheld portable dental X-ray equipment: a position paper prepared by the European Academy of DentoMaxilloFacial Radiology (EADMFR); Dentomaxillofacial Radiology (2015) 44, 20140343.
3. Essig SL. New York moves to facilitate the use of hand-held X-ray devices. N Y State Dent J 2009; 75: 57.
4. International standard, medical electrical equipment—part 1–3: general requirements for basic safety and essential performance— collateral standard: radiation protection in diagnostic X-ray equipment. IEC 60601-1-3 ed2.1 Consol. with am1. 2013. Geneva, Switzerland: International Electrotechnical Commission.
5. International standard, medical electrical equipment—part 2-65: particular requirements for the basic safety and essential performance of dental intra-oral X-ray equipment. IEC 60601-2-65 ed1.0. 2012. Geneva, Switzerland: International Electrotechnical Commission.
6. International standard, evaluation and routine testing in medical imaging departments—part 3–4: acceptance tests—imaging performance of dental X-ray equipment. IEC 61223-34 ed1.0. 2000. Geneva, Switzerland: International Electrotechnical Commission.
7. D N S V Ramesh, Mahalakshmi Wale, R Thriveni, Amit Byatnal; Hand- held X- ray Device: A Review; Journal of Indian Academy of Oral Medicine & Radiology | Volume 30 | Issue 2 | April- June 2018
8. Pittayapat P, Oliveira-Santos C, Thevissen P, Michielsen K, Bergans N, Willems G, et al. Image quality assessment and medical physics evaluation of different portable dental X-ray units. Forensic Sci Int 2010; 201: 112–17. doi: 10.1016/j.forsciint.2010.04.041
9. US Department of Health and Human Services; Food and Drug Administration Centre for Devices and Radiological Health; Diagnostic Devices; Branch Division of Mammography Quality and Radiation Programs; Office of Communication, Education, and Radiation Programs. Guidance for industry and FDA staff radiation safety considerations for X-Ray equipment designed for hand-held use.
10. Pittayapat P, Jacobs R, De Valck E, Vandermeulen D, Willems G. Forensic odontology in the disaster victim identification process. J Forensic Odontostomatol 2012; 30:1-12.

**How to cite this article:** Patil G, Kadam V, Kale L, Sodhi S. A Paradigm Shift from Mounted Intra-Oral Periapical Radiography to Hand-Held X-Ray Device: A Review. Ann. Int. Med. Den. Res. 2019; 5(6):DE25-DE27.

**Source of Support:** Nil, **Conflict of Interest:** None declared